

Amendment and Response  
 U.S. Serial No. 10/782,363  
 June 1, 2006  
 Page 3

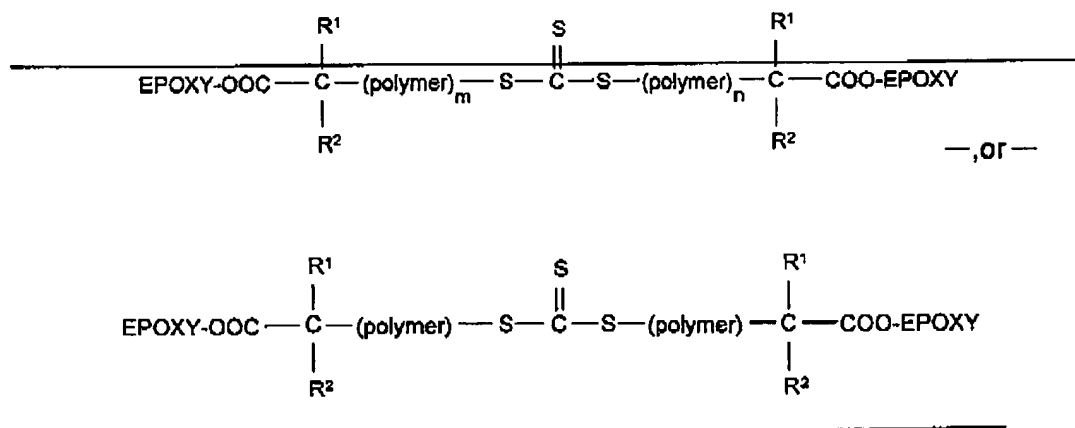
# IN THE CLAIMS:

1. (amended) A vinyl ester ~~toughener~~, comprising:

the reaction product of a ~~toughener~~ polymer or copolymer and an unsaturated monocarboxylic acid;

~~said unsaturated acid being a monoacid~~ containing from 3 to about 10 carbon atoms;

said ~~toughener~~ polymer or copolymer having the formula:



Formula X<sup>1</sup>

wherein R<sup>1</sup> and R<sup>2</sup>, independently, are selected from an alkyl having 1 to about 6 carbon atoms; an alkyl having from 1 to about 6 carbons carbon atoms and substituted with 1 or more substituents selected from an alkyl having 1 to 6 carbon atoms, aryl, a halogen atom, a cyano group, a nitro group, and an ether group containing from 2 to about 20 carbon atoms; at least one aryl; or at least one substituted aryl having from 1 to about 6 substituents on the aryl ring selected from an alkyl having 1 to 6 carbon atoms, aryl, a halogen atom, a cyano group, a nitro group, and an ether group containing from 2 to about 20 carbon atoms;

wherein each EPOXY group, independently, is derived from glycidyl ether of a novolac resin; phenolic novolac epoxy, tetraphenylethane epoxy, glycidyl ether of mononuclear di- and trihydric phenol; glycidyl ether of bisphenol; glycidyl ether of polynuclear phenol; epoxy resin derived from diphenolic acid; glycidyl ether of aliphatic polyol; glycidyl ester; glycidyl epoxy

Amendment and Response  
 U.S. Serial No. 10/782,363  
 June 1, 2006  
 Page 4

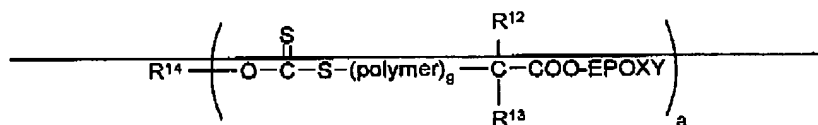
containing nitrogen; glycidyl derivative of cyanuric acid; glycidyl resin derived from melamine; glycidyl amine; thioglycidyl resin; silicon-glycidyl resin; fluorine glycidyl resin; epoxy resin synthesized from monoepoxides other than epihalohydrin; epoxy resin synthesized from unsaturated monoepoxides; epoxy resin synthesized from monoepoxy alcohol; epoxy resin synthesized from monoepoxides by ester interchange; epoxy resin synthesized from glycidaldehyde; polyglycidyl compound containing unsaturation; and epoxy resins synthesized from olefins and chloroacetyl; and

wherein (polymer) is polymerized from a monomer selected from a conjugated diene monomer; a vinyl containing monomer; and combinations thereof.

~~, and wherein said one or more substituents, independently, comprises an alkyl having from 1 to 6 carbon atoms, or an aryl, or a halogen group, or a cyano group, or an ether having a total of from 2 to about 20 carbon atoms, or a nitro group, or combinations thereof;~~

~~wherein m and n, independently, is a repeat unit of from about 5 to about 1,000; or~~

~~— said toughener polymer or copolymer having the formula:~~



Formula H<sup>1</sup>

~~— wherein R<sup>12</sup> and R<sup>13</sup>, independently, can be the same or different, can be a linear or branched alkyl having from 1 to about 12 carbon atoms; or an aryl group having from 6 to about 18 carbon atoms, optionally containing heteroatoms; or R<sup>12</sup> and R<sup>13</sup> can form or be a part of a substituted or unsubstituted cyclic ring having from 3 to about 12 carbon atoms;~~

~~— wherein R<sup>14</sup> is optionally substituted, and can be a linear or branched alkyl having from 1 to about 12 carbon atoms, an aryl group optionally saturated or unsaturated; an arylalkyl having from about 7 to about 18 carbon atoms; an acyl group; an alkene group; an alkenealkyl having from 3 to about 18 carbon atoms; an alkylene group; an alkoxyalkyl; derived from a polyalkylene~~

### Amendment and Response

U.S. Serial No. 10/782,363

June 1, 2006

Page 5

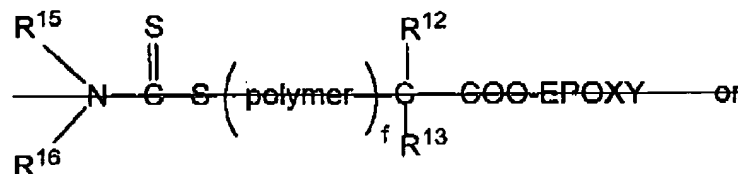
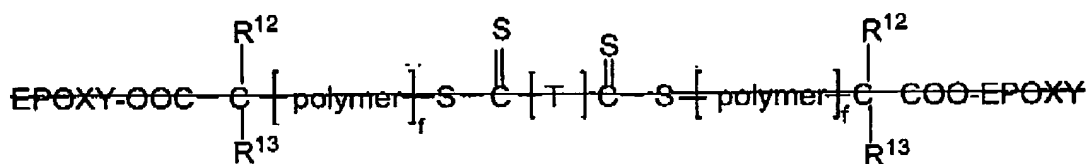
glycol; derived from a polyalkylene glycol monoalkyl ether having from about 3 to about 200 carbon atoms; derived from a polyalkylene glycol monoaryl ether having from about 3 to about 200 carbon atoms; a polyfluoroalkyl; a phosphorus-containing alkyl; or a substituted or unsubstituted aryl ring containing heteroatoms;

~~wherein said (polymer) is derived from at least one conjugated diene monomer, or a vinyl containing monomer or combinations thereof, with the proviso that each polymer repeat unit can be the same or different;~~

~~wherein said g is from about 1 to about 10,000; and~~

~~wherein said "a" is 1 to about 4; or~~

~~\_\_\_\_\_said toughener polymer or copolymer being a dithiocarbamate having the formula:~~

~~Formula F<sup>1</sup>~~

~~Formula G<sup>1</sup>~~

wherein each  $R^{12}$  and  $R^{13}$ , independently, is the same or different, is optionally substituted, and is a linear or branched alkyl having from 1 to about 12 carbon atoms; or an aryl group having from 6 to about 18 carbon atoms, optionally containing heteroatoms; or  $R^{12}$  and  $R^{13}$  can form and be part of a substituted or unsubstituted cyclic ring having from 3 to about 12 carbon atoms;

~~wherein R<sup>15</sup> and R<sup>16</sup>, independently, is the same or different, optionally substituted, optionally contains heteroatoms, and is hydrogen; or a linear or branched alkyl having from 1 to about 18 carbons; or an aryl group having from 6 to about 18 carbon atoms, optionally saturated~~

Amendment and Response  
 U.S. Serial No. 10/782,363  
 June 1, 2006  
 Page 6

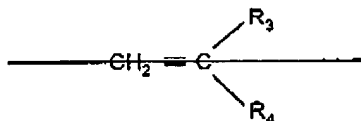
~~or unsaturated; or an arylalkyl having from 7 to about 18 carbons; or an alkenealkyl having from 3 to about 18 carbon atoms; or derived from polyalkylene glycol ether; or derived from an amine; or R<sup>15</sup> and R<sup>16</sup> are in the form of a substituted or unsubstituted cyclic ring with the nitrogen atom having a total of 4 to about 12 carbon atoms; —~~

~~— wherein T is a divalent radical having a nitrogen atom directly connected to each carbon atom of the two thiocarbonyl groups;~~

~~— wherein said (polymer) repeat units are derived from at least one conjugated diene monomer, or a vinyl containing monomer, or combinations thereof, with the proviso that each repeat unit can be the same or different; and~~

~~— wherein the number of said repeat units f, independently, is from 1 to about 10,000.~~

2. (amended) A vinyl ester toughener according to claim 1 38, wherein said Formula X<sup>1</sup> (polymer), independently, ~~comprises~~ is selected from a polyacrylate or polymethacrylate derived from an alkyl acrylate or alkyl methacrylate monomer wherein said alkyl has from 1 to about 18 carbon atoms, a polymer derived from a vinyl substituted aromatic monomer containing from 8 to about 12 carbon atoms, a polymer derived from a conjugated diene monomer containing from 4 to about 12 carbon atoms, a polymer derived from acrylonitrile, or combinations thereof, or wherein said Formula II<sup>1</sup> conjugated diene monomer has from 4 to 12 carbon atoms, and wherein said vinyl containing monomer has the formula:



~~— wherein R<sup>3</sup> comprises hydrogen, halogen, C<sub>1</sub>—C<sub>4</sub> alkyl, or substituted C<sub>1</sub>—C<sub>4</sub> alkyl wherein said substituents, independently, comprise one or more hydroxy, alkoxy, aryloxy(OR<sup>5</sup>), carboxy, acyloxy, aryloxy(O<sub>2</sub>CR<sup>5</sup>), alkoxy-carbonyl(CO<sub>2</sub>R<sup>5</sup>), or aryloxy-carbonyl; N-pyrrolidonyl;~~

~~— wherein R<sup>4</sup> comprises hydrogen, R<sup>6</sup>, CO<sub>2</sub>H, CO<sub>2</sub>R<sup>5</sup>, COR<sup>5</sup>, CN, CONH<sub>2</sub>, CONHR<sup>6</sup>, O<sub>2</sub>CR<sup>5</sup>, OR<sup>5</sup> or halogen; and~~

## Amendment and Response

U.S. Serial No. 10/782,363

June 1, 2006

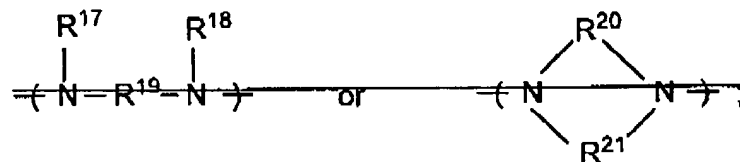
Page 7

wherein  $R^5$  comprises  $C_4$ – $C_{18}$  alkyl, substituted  $C_4$ – $C_{18}$  alkyl,  $C_2$ – $C_{18}$  alkenyl, aryl, heterocyclyl, aralkyl, or alkaryl, and wherein said substituents, independently, comprise one or more epoxy, hydroxy, alkoxy, acyl, acyloxy, carboxy, (and salts), sulfonic acid (and salts), alkoxy or aryloxy carbonyl, dicyanato, cyano, silyl, halo or dialkylamino, and

wherein  $g$  is from about 3 to about 5,000; or

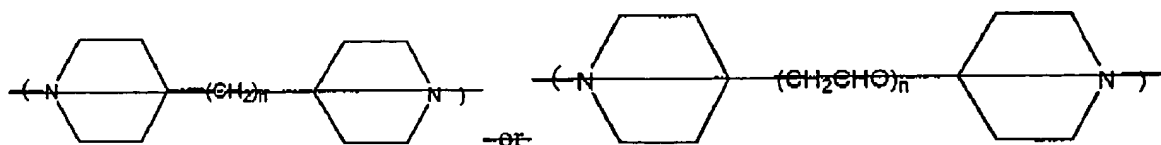
wherein in said Formula F<sup>1</sup> and G<sup>1</sup> toughener polymer or copolymer  $f$  is from about 3 to about 5,000;

wherein T is:



wherein  $R^{17}$  and  $R^{18}$ , independently, is the same or different, is optionally substituted, and is hydrogen; or a linear or branched alkyl having from 1 to about 18 carbon atoms; or an aryl group having from about 6 to about 18 carbon atoms; or an arylalkyl having from 7 to about 18 carbon atoms; or a alkenealkyl having from 3 to about 18 carbon atoms; wherein  $R^{19}$  is optionally substituted, or is non-existent; or an alkylene group having from 1 to about 18 carbon atoms; or derived from a polyalkylene glycol either having from 3 to about 200 carbon atoms; wherein  $R^{20}$  and  $R^{21}$ , independently, is the same or different, and is optionally substituted, and is an alkylene group having from 1 to about 4 carbon atoms, or

wherein T is:



wherein  $n$  is 0 to about 18.

3. (amended) A vinyl ester toughener according to claim 2, wherein each said EPOXY, independently, is derived from a polyhydric phenol polyether alcohol; glycidyl ether of a novolac resin; phenolic novolac epoxy; tetraphenylethane epoxy; glycidyl ether of mononuclear di- and

## Amendment and Response

U.S. Serial No. 10/782,363

June 1, 2006

Page 8

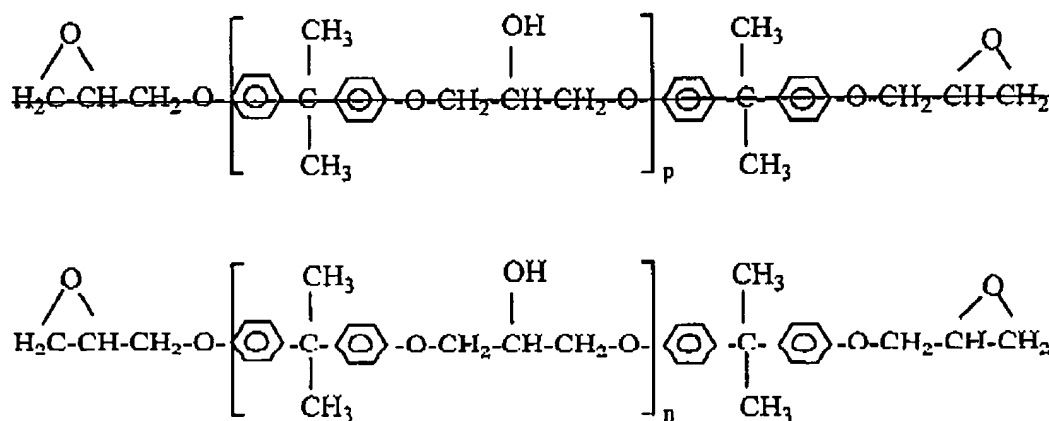
~~trihydric phenol; glycidyl ether of bisphenol; glycidyl ether of polynuclear phenol; epoxy resin derived from diphenolic acid; glycidyl ether of aliphatic polyol; glycidyl ester; glycidyl epoxy containing nitrogen; glycidyl derivative of cyanuric acid; glycidyl resin derived from melamine; glycidyl amine; thioglycidyl resin; silicon glycidyl resin; fluorine glycidyl resin; epoxy resin which is synthesized from monoepoxy other than epichlorohydrin including an epoxy resin derived from unsaturated monoepoxy; epoxy resin derived from monoepoxy alcohol; epoxy resin derived from monoepoxy by ester interchange; epoxy resin derived from glycidaldehyde; polyglycidyl compound containing unsaturation; epoxy resin which is synthesized from olefin and chloroacetyl; or an epoxy resin adduct of the above, or combinations thereof;~~

~~— wherein m and n of Formula X<sup>1</sup>, independently, is from about 7 to about 150, and wherein said unsaturated monocarboxylic acid is acrylic acid, methacrylic acid, crotonic acid, cinnamic acid, or combinations thereof.~~

4. cancel

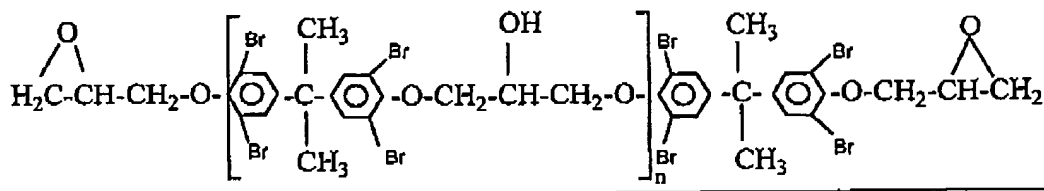
5. (amended) A vinyl ester toughener according to claim 1, wherein in Formula X<sup>1</sup>, m and n, independently, are from about 10 to about 200,

~~— wherein each said EPOXY in Formula X<sup>1</sup>, F<sup>1</sup>, G<sup>1</sup>, and H<sup>1</sup>, independently, is independently derived from an epoxide represented by the formulae:~~

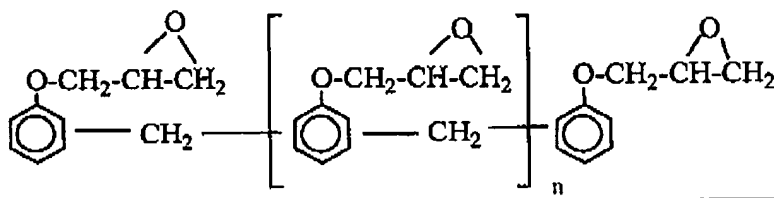


Amendment and Response  
 U.S. Serial No. 10/782,363  
 June 1, 2006  
 Page 9

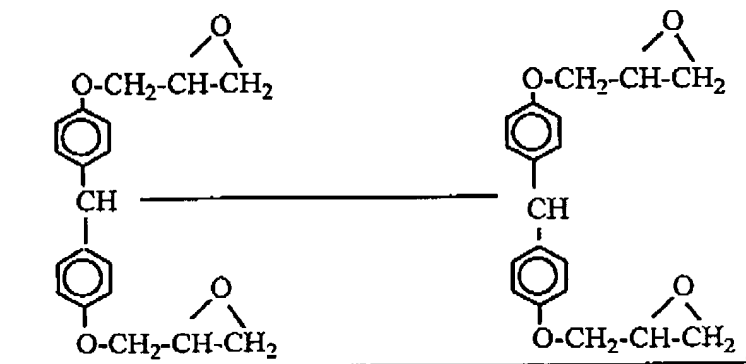
wherein n is 0 to about 18,



wherein n is 0 to about 18,



wherein n is 0 to about 8, and



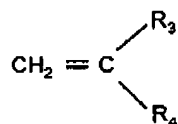
wherein p is from 0.1 to about 1.5, and

wherein the number of said terminal EPOXY groups is from about 1 to about 2.

6. to 37. cancel

Amendment and Response  
U.S. Serial No. 10/782,363  
June 1, 2006  
Page 10

38 (new) A vinyl ester according to claim 1, wherein said conjugated diene monomer has from 4 to 12 carbon atoms, and said vinyl containing monomer is represented the formula:



wherein  $\text{R}^3$  is selected from hydrogen; halogen;  $\text{C}_1 - \text{C}_4$  alkyl; substituted  $\text{C}_1 - \text{C}_4$  alkyl, wherein said substituents are selected from hydroxy, alkoxy, aryloxy( $\text{OR}^5$ ), carboxy, metal carboxylate ( $\text{COOM}$ ) with M selected from sodium, potassium, calcium, zinc and an ammonium salt; acyloxy; aryloxy( $\text{O}_2\text{CR}^5$ ); alkoxy-carbonyl( $\text{CO}_2\text{R}^5$ ); aryloxy-carbonyl; and N-pyrrolidonyl;

wherein  $\text{R}^4$  is selected from hydrogen;  $\text{R}^5$ ;  $-\text{CO}_2\text{H}$ ;  $-\text{CO}_2\text{R}^5$ ;  $-\text{COR}^5$ ;  $-\text{CN}$ ;  $-\text{CONH}_2$ ;  $-\text{CONHR}^5$ ;  $-\text{O}_2\text{CR}^5$ ;  $-\text{OR}^5$ ; and halogen;

wherein  $\text{R}^5$  is selected from  $\text{C}_1 - \text{C}_{18}$  alkyl; substituted  $\text{C}_1 - \text{C}_{18}$  alkyl wherein said substituents are selected from epoxy, hydroxy, alkoxy, acyl, acyloxy, carboxy and salts thereof, sulfonic acid and salts thereof, alkoxy, aryloxy-carbonyl, dicyanato, cyano, silyl, halo and dialkylamino;  $\text{C}_2 - \text{C}_{18}$  alkenyl; aryl; heterocyclyl; aralkyl; and alkaryl.